Graduate International Colloquia Grant

Challenges of Mathematical Modeling and Numerical Computation in Finance

September 3-4, 2009

Abstracts

Ren Chen

Some Reflections on the Current State of Financial Mathematics

The objective of the presentation is to analyze the consequences of applying existing mathematical asset pricing models within a nonlinear macro system. These models, no matter how sophisticated, imparted a false sense of security and underestimated both local and systemic risk. The pricing formulae were based upon static linear assumptions from historical data. The large-scale application of such formulae changes the fundamental properties of the asset being priced. There were also destabilizing non-linear triggers within the system such as dissolution clauses in CDOs. Once triggered, there is a cascade effect that adversely affects liquidity and could lead to a financial crisis.

We will construct a Credit Default Swap on the spot and try to price it by standard methods and follow through the systemic consequences in a four movement symphony: introduction to grand finale.

Jerome Stein

Application of Stochastic Optimal Control to Financial Market Debt Crises

This interdisciplinary paper explains how mathematical techniques of stochastic optimal control can be applied to the recent subprime mortgage crisis. Why did the financial markets fail to anticipate the recent debt crisis, despite the large literature in mathematical finance concerning optimal portfolio allocation and stopping rules? The uncertainty concerns the capital gain, the return on capital and the interest rate. An optimal debt ratio is derived where the drift is probabilistic but subject to economic constraints. The vulnerability of the borrowing firm to shocks from the capital gain, the return to capital or the interest rate, does not depend upon the actual debt/net worth per se. Instead it increases in proportion to the difference between the Actual and Optimal debt ratio, called the excess debt. A general measure of excess debt is derived and I show that it is an early warning signal of the recent crisis.

Jichuan Yang

How Much Capital is Adequate for a Derivatives Product Company? The Gaussian Copula model was widely used in the structured credit market. Here we present a new application of the model in creation of a highly leveraged and highly rated financing company. Such a financing company, the so called Derivatives Product Company (DPC) was able to achieve the highest ratings from the top two rating agencies, therefore enjoyed full access to low cost funding. However, the DPC was also able to use the low cost funding to invest in a variety of assets and securities, many of which were illiquid, non-investment grade, and high yielding. The DPC was a complex financial structure of a large size. Its investment portfolio consisted of many types of financial securities including RMBS, CMBS, ABS and CDO; as well as corporate bonds and leveraged loans. Moreover, the investment of these securities was through derivatives transactions, more specifically, the total return swaps. On the financing side, the DPC was able to raise debt capital with various tenors ranging from 30 day Commercial Papers to five year Mid Term Notes. Because the DPC born the highest ratings as short and long term debt issuers, as well as derivatives counterparty, the DPC was able to enjoy the best terms in any OTC derivatives transactions and the lowest funding cost. We demonstrate how all these were achieved by efficient employment of tools in financial engineering. We also make attempts to discuss the moral hazard imbedded in the structuring process. The role of financial engineering is no longer a passive tool being used for fair market valuation of a financial instrument. It has become a powerful driver for the building of complex financial structures and systems. While greatly enhancing the overall market liquidity, it may also have helped to create the largest asset bubble in the history of finance.

Tao Pang

Pricing Mortgage-Backed Securities (MBS) and the Risk Analysis

Sub-prime mortgages and the related mortgage-backed security (MBS) have been regarded as one trigger of the recent finance crisis. In this paper,we will introduce the MBS products and the numerical methods to price them. First, we will introduce the creation of basic MBS products as well as some more advanced products. Then the pricing methods of MBS products will be introduced. In particular, we will consider the Monte-Carlo Method to evaluate the MBS securities and the associated Greeks. Further, we will investigate the convergence issue of the MBS and the associated Greeks. Finally, we will consider the risks associated with MBS products and its evaluation. In particular, we will consider the interest risk, prepayment risk and default risk. In result of the analysis into MBS products, we hope to better understand the current state of the mortgage and home-buying industry in the current financial crisis.

Steven Zhu

Evolution of the financial models: a personal journey?

Abstract to be announced.